

Risk Assessment Model -- Calculation of Potential Risks from Consumption of Human Milk

Chemical	Conc in Fish Cf (mg/kg)	Slope Factor Sfo (mg/kg/day)-1	Intermediate MRL (mg/kg/day)	Chronic RfD (mg/kg/day)	Half-life h (days)	Mother ADDm (ug/kg/day)	Milk Cmf (ug/kg-lipid)	Milk Cmf (ug/L)	Initial Mother PCB Body Burden (ug)	3-month (= 6-month avg) Mother PCB Body Burden (ug)	6-month Mother PCB Body Burden (ug)	Infant ADDca-i (mg/kg/day)	Infant ADDnc-i (ug/kg/day)	Infant/Mother Exposure Ratio	Excess Lifetime Cancer Risk Mother ELCRm	Infant ELCRi	Infant/Mother Risk Ratio	Hazard Quotient Mother HQm	Quotient Infant HQi	Infant/Mother Risk Ratio		
PCB 153 (0.5 yr) Intervention (See separate spreadsheet)	1	2	0.00003	0.00002	10038	0.281 0.150	6109 3262	244 130	1.2E+08 6.3E+07	210 112	1.0E+05 5.4E+04	180 96	8.6E+04 4.6E+04	0.376 0.201	26 14	94 94	2.4E-01	7.5E-01	3.1	14063	876872	62
Subject 210	NA	2	0.00003	0.00002	10038	0.0337	733	29	1.4E+03	25	1.2E+04	22	1.0E+04	0.045	3.16	94						
Subject 93	NA	2	0.00003	0.00002	10038	0.0154	334	13	6.4E+03	11	5.5E+03	10	4.7E+03	0.021	1.44	94						
Subject 222	NA	2	0.00003	0.00002	10038	0.0088	192	8	3.7E+03	6.6	3.2E+03	5.7	2.7E+03	0.012	0.83	94						
Subject 199	NA	2	0.00003	0.00002	10038	0.0075	163	6.5	3.1E+03	5.6	2.7E+03	4.8	2.3E+03	0.010	0.70	94						
Subject 55	NA	2	0.00003	0.00002	10038	0.0064	139	5.6	2.7E+03	4.8	2.3E+03	4.1	2.0E+03	0.009	0.60	94						
Subject 159	NA	2	0.00003	0.00002	10038	0.0057	124	5.0	2.4E+03	4.3	2.0E+03	3.6	1.8E+03	0.008	0.53	94						
Subject 265	NA	2	0.00003	0.00002	10038	0.0039	84	3.4	1.6E+03	2.9	1.4E+03	2.5	1.2E+03	0.005	0.36	94						
Subject 236	NA	2	0.00003	0.00002	10038	0.0015	33	1.3	6.3E+02	1.1	5.4E+02	1.0	4.6E+02	0.002	0.14	94						

Notes:

Acceptable levels are ELCR = 1E-6 and HQ = 1

Equations

$$\text{ADDm} = (\text{Cf} \times \text{Irf} \times \text{Conv} \times \text{Ff}) / \text{BWm}$$

$$\text{ADDca-i} = (\text{Cmf} \times \text{IRMadj} \times \text{f3} \times \text{f4} \times \text{f5} \times \text{Edi} \times \text{Ef}) / (\text{Atb})$$

$$\text{ELCRm} = \text{ADDm} \times \text{Sfo} \times 30 / 70 \quad \text{ELCRm adjusted to 30-year exposure}$$

$$\text{ELCRi} = \text{ADDca-i} \times \text{Sfo}$$

$$\text{Cmf} = (\text{ADDm} \times \text{h} \times \text{f1}) / (\ln 2 \times \text{f2}) \text{ for 7 year halflife}$$

$$\text{Cmf} = (\text{ADDm} \times \text{h} \times \text{f1}) * 0.5 / (\ln 2 \times \text{f2}) \text{ for 27.5 year halflife}$$

$$\text{ADDnc-i} = (\text{Cmf} \times \text{IRMadj} \times \text{f3} \times \text{f4} \times \text{f5})$$

$$\text{HQm} = \text{ADDm} / \text{RfD}$$

$$\text{HQi} = \text{ADDca-i} / \text{MRL}$$

Default Values

Cf	chemical specific	mg/kg	Concentration of chemical in fish
Irf		18 g/day	Mother's ingestion rate of fish
Conv	0.001	kg/g	Conversion factor
Ff	1	fraction	Fraction of fish contaminated
BWm	64	kg	Body weight of mother
h	chemical specific	days	Half-life of chemical in body
Fone	0.9	fraction	Fraction of ingested chemical stored in fat
Ftwo	0.3	fraction	Fraction of mother's weight that is fat
IRMadj	0.149	kg/kg/day	Infant's ingestion rate of milk (averaged over exposure duration)
Fthree	0.04	fraction	Fraction of human milk that is fat
Ffour	0.9	fraction	Fraction of ingested chemical that is absorbed
Ffive	0.543	fraction	Fraction of initial chem conc present during year
Edi	1	year	Exposure duration of breast-feeding infant
Efi	365	days/year	Exposure frequency of breast-feeding infant
Atc	25550	days	Averaging time - carcinogens (70 years)
Sfo	chemical specific	(mg/kg/day)-1	Slope Factor - oral
RfD	chemical specific	mg/kg/day	Reference Dose - oral
Conv2	1.00E-06	kg/m3	Conversion factor 2

Calculated Values	
ADDm	mg/kg/day
Cmf	mg/kg-lipid
ADDca-i	mg/kg/day
ADDnc-i	mg/kg/day
ELCRm	risk
ELCRi	risk
HQm	quotient
HQi	quotient

Calculation of F5 (see Attachment 2 to Appendix C of draft DEQ Human Health Risk Assessment Guidance)

k	calculated	(days)-1	rate constant for chemical loss in body = ln(2)/h
b		0.9 kg/day	daily secretion of milk
c	calculated	fraction	fraction of chemical lost in human milk per day
hb	calculated	days	maternal half-life for breastfeeding
kb	calculated	(days)-1	rate constant for chemical loss by breastfeeding = ln(2)/hb
	kb = k + c + b * f1 * f3 / (BWm * h2)		
b'0	150	ml/kg/day	mean milk intake rate 0 to 3 months
b'91	140	ml/kg/day	mean milk intake rate 3 to 6 months
b'183	110	ml/kg/day	mean milk intake rate 6 to 9 months
	83	ml/kg/day	mean milk intake rate 9 to 12 months
	145	ml/kg/day	mean milk intake rate 0 to 6 months
	121	ml/kg/day	mean milk intake rate 0 to 12 months
	1.03	g/ml	density of milk
	149	g/kg/day	mean milk intake rate 0 to 6 months
	0.149	kg/kg/day	mean milk intake rate 0 to 6 months
	124	g/kg/day	mean milk intake rate 0 to 12 months
	0.124	kg/kg/day	mean milk intake rate 0 to 12 months

Maternal Breastfeeding Half-life hb (days)

$$317$$

$$354$$

$$395$$

approximately 1 year

Half-life h (days)	Cmf _{kfat91}		Cmf _{kfat183}		b'91 b'0	b'183 b'0	Six months of exposure f5	One year of exposure f5
	k	kb	Cmf _{kfat0}	Cmf _{kfat0}				
1387	0.000500	0.00219	0.861	0.746	0.933	0.733	0.803	0.547
2555	0.000271	0.00196	0.859	0.740	0.933	0.733	0.802	0.543
10038	0.000069	0.00176	0.858	0.736	0.933	0.733	0.801	0.540